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## THE INTERNAL COMBUSTION ENGINE INDUSTRY IN INDIA\*

OF the various types of Internal Combustion Engines, the diesel engine industry has become well established in India and a few firms have, on production, engines of indigenous design. These engines are usually of the single cylinder horizontal and vertical type, generally used as a power-plant or drive for pumps. Most of the component parts for the engines are now made in India, but the finer components like the injection pump and nozzle are yet being imported. A report, however, is now being prepared by the National Physical Laboratory of India and the Secretary to the I.C.E.R. Committee on the possibilities of undertaking the manufacture of injection pumps and nozzles. The experience of one firm in India in the use of high duty cast irons for the cylinder head and crankshaft should prove extremely valuable in saving the use of scarce

alloying elements like nickel, vanadium, molybdenum, etc. The diesel engine industry is now looking forward to the production of high-speed heavy duty transport vehicle engines, which should naturally be of the multicylinder type. An important bottle-neck in this is the combustion chamber which is invariably guarded by rigorous patents abroad. It is now proposed to take up a research scheme on the development of a combustion chamber suitable for this purpose, and it is hoped that in the next three or four years when this development may be fruitful, the Indian industry may undertake manufacture of multicylinder engines of their own design.

The automobile industry is gradually gaining ground in the country, but of the various firms who are engaged in this section of the industry, there is only one that has gone into the production of engines even on a limited scale. It is, however, gratifying to note that there is now one complete machine shop for the machining of all principal parts of an engine, and a foundry is getting ready for the preparation of all major castings.

\* Abstract of Address by Dr. J. C. Ghosh, Chairman, Internal Combustion Engine Research Committee, at the Symposium on Problems Relating to the Development of Internal Combustion Engine Industry in India, held on the 5th April 1952, at the Indian Institute of Science, Bangalore.

In this connection, I may mention two factors which should receive the attention of everyone interested in the development of a large-scale industry, viz., the importance of the design and development section, and the inspection department. In all mass production on assembly line principles, the design and production planning offices hold the key to the success of any endeavour. One has only to see the catalogue of parts listed for the assembly of an engine to realise the enormous design and planning effort that has gone into the production of a simple engine. We often find that in India little importance is given to this aspect of production.

Standardisation and inspection play an equally important part. If the consumer is to have faith in an indigenous article, it is absolutely necessary that the product is of defined and consistent quality. From the producer's point of view, of course, the need for standardisation is essential when provision has to be made for exchange of parts from one unit to another. The variety of materials and processes that goes into the making of an engine naturally demands a capable inspectorate having authority to reject doubtful products. A greater realisation of the importance of this fact should help place our industry on a much better footing, and our products on a level comparable to similar products from abroad.

Speaking in broad terms about an industry of the type and magnitude of the Internal Combustion Engine, one might remember that the manufacture of an engine is usually achieved by a group of subsidiary industries, each of which is specialising in a component part of the engine. There are certain factories exclusively organised for the manufacture of such parts as spark plugs and injection pumps and nozzles, and many subsidiary organizations for the manufacture of standardised pistons and rings and the casting or forging of crankshafts and connecting rods. Such a subsidiary industry has not yet started in India, though again it is very encouraging to note that one firm has now taken up the manufacture of pistons and rings of standardised design and specifications. In this connection, I may mention that valuable reports have been drawn up on the design and manufacture of spark plugs, pistons and rings; and I commend them to those who are interested in the manufacture of these component parts.

During the last three years, considerable interest has been shown in the development of the gas turbine power plant. It is true that the reciprocating engine industry itself has not yet

developed fully, and it will be still sometime before we can claim to have indigenous designs on production lines. All the same, the gas turbine has become such an important power plant that it has been considered advisable to start at least two main centres of research and development in this field. Some facilities for advanced instruction in the design, operation and testing of gas-turbines are also now available in the laboratory of the Indian Institute of Science.

The main problems relating to the Internal Combustion Engine industry fall into two groups: (a) fuels that have to be burnt in engines, and (b) materials which may be used in the fabrication of engines.

The major fuel for the Internal Combustion Engine is yet the liquid fuel. About 40 per cent. of the liquid fuel in use belongs to the gasoline class. Our own resources in this direction are poor. But two refineries have now been started in India which should give us greater confidence in regard to a regular supply of gasoline. When thermal cracking had reached what appeared to be the final stage of development a few years ago, the maximum octane number level was rather low. However, with the advent of catalytic cracking the petroleum industry developed another tool which has made possible the production of a larger percentage of gasoline from a barrel of crude oil at a higher octane number level than could be attained by thermal cracking.

This brings us to the question of high octane fuels. During the last two decades, as the demand for high-powered engines increased there has been a continuous increase in the octane numbers of gasolines used in engines. Increased power has demanded higher compression ratios, and this has resulted in every means being employed to improve the octane numbers. The discovery of tetra-ethyl lead and other octane increasing compounds has given further fillip to this race for higher and even higher compression ratios. Recently, however, there is a shift in emphasis in obtaining high compression ratios. Instead of going in for higher octane fuels, an attempt is being made at obtaining the same result by altering the design of the combustion chamber. Studies in this field call for fundamental investigations on the nature of combustion of liquid fuel particles, the movement of the flame front and the nature of chemical reaction during the movement of the flame.

The next important liquid fuel is the heavier diesel fuel. The two-stroke diesel engine, in

some ways, is the future reciprocating power plant of the world. The major advance in diesels to-day is not so much in the improvement in the quality of fuels as in the super-charging of these engines. Super-charging is better than the method of increasing the compression ratio, because of the considerably less maximum pressures in the former case, thus permitting less heavy stress-bearing components and therefore a lighter engine.

Alcohol comes as the next major liquid fuel. Considerable importance is being attached to the power alcohol industry by the Government, and before long, we may have sizeable resources on hand to make greater use of this fuel. About 20 per cent. mixture with motor gasoline has now come to be recognised as a suitable fuel for most vehicles. But the approach to this problem of utilizing alcohol perhaps needs a revision. Serious attempts should be made to design an engine primarily for running on a high percentage mixture of alcohol and gasoline. A discussion on liquid fuels would be incomplete to-day without a few words on kerosene. Being not subject to any duty, superfine kerosene is nearly half as cheap as petrol. Of course, it has gained exceptional value as a fuel with the advent of the gas turbines, which run

mostly on kerosene when used for air transport. We, in this country, should be especially interested in the use of kerosene as a fuel for our agricultural machinery.

Finally, reference must be made to solid fuels which are now being increasingly recognised as the future economic fuel for stationary power plants. We have in this country almost inexhaustible sources of low grade coal, and it should be our earnest endeavour to find a power plant that can burn it economically and with a high efficiency. The combustion of pulverised coal presents many problems like ash deposition, carbon deposition, corrosion of metal chambers, etc., which I have referred to earlier. But the most interesting study is the combustion of coal particle itself. I hope the Fuel Research Institute will take up in hand this fundamental problem for careful investigation.

I hope that the co-operation between Government, the Council of Scientific and Industrial Research, the industry and research workers, which is so evident in this Symposium, will extend to the development of the Internal Combustion Engine Industry in India. May this co-operation lead to the establishment of a flourishing industry in the country!

#### PROGRESS IN TECHNICAL EDUCATION

IN the course of his address to the 19th meeting of the Central Advisory Board of Education held recently, the Hon'ble Maulana Abdul Kalam Azad, Minister for Education, Government of India, observed as follows:

On the recommendations of the All-India Council for Technical Education and the Scientific Man-Power Committee, large grants have been made to Universities and other higher technical institutions. In the first phase of the development programme, fourteen technical institutions in different parts of the country were selected and capital grants amounting to over Rs. 1½ crores and loans over Rs. 32 lakhs were approved in 1949 for improving their capacity and standards. Out of the amounts promised, over Rs. 90 lakhs as grants and Rs. 30 lakhs as loans have already been paid. During the same period, over Rs. 135 lakhs have been paid as capital and almost half a crore as recurring grants to the Indian Institute of Science, Bangalore. As a result, the Institute is in a position to-day to undertake post-graduate teaching and research in many of the fundamental branches of science and technology. The Delhi Polytechnic has also

been greatly developed and will serve as the Faculty of Technology of the Delhi University.

Besides, the Indian Institute of Technology at Kharagpur, which will impart teaching of the highest standard and provide facilities for research in many of the most important aspects of engineering and technology, was formally opened in August last year. The staff, recruited from many countries, include some of the best experts available in the field.

In this connection, grateful acknowledgment is made to the assistance received through the UNESCO Technical Assistance Programme, under which the services of several distinguished technical experts were made available. We have also received the offer of 9 Scholarships and Fellowships for our students and equipment worth over \$ 100,000. In addition, a number of our teachers and other educational workers have been given the opportunity to receive training or participate in study tours under the Fulbright and allied schemes. All these are evidences of international co-operation in the field of education, which are welcome not only on their own account but also because they help to promote better international understanding.

## VARIOLITES FROM CHITALDRUG DISTRICT, MYSORE STATE

C. S. PICHAMUTHU

*Director, Mysore Geological Department, Bangalore*

AS early as 1904, Mr. P. Sampat Iyengar<sup>1</sup> had noticed that the "Grey Trap" near Jogimardi often contained "small rounded protuberances which stand out prominently on weathered surfaces". While he thought it probable that "these nodules may represent the spherulites in the trap", he believed that this peculiar structure was "the result brought about by movement of the extrusive trap". Some of them were also considered by him to be amygdaloids.

In 1930, the present writer while describing the trap rocks of the Chitaldrug Schist Belt, had occasion to examine some of the specimens and slides collected by Mr. Sampat Iyengar, and he found that the spots, patches and nodules found in these traps were not amygdaloids, but were either segregations of secondary materials or varioles.<sup>2</sup> Recent field work has shown that this interpretation was correct, and this note gives a brief description of these interesting variolites from the Chitaldrug Area.

The occurrence of pillow lavas of Dharwar age, containing well-defined typical pillow structures, was recently reported by the writer<sup>3</sup> from the Chitaldrug District. In several parts of this volcanic field, variolitic traps have been developed. An almost continuous zone is seen to stretch in a north-south direction from about a mile south of Chitaldrug Town to Kurubarmaradikere, a distance of nearly five miles. Very good localities are (i) the road cutting near Kunchiganhal, (ii) the valley south of

Ingladhah, and (iii) the western bank of Kurubarmaradikere Tank.

These variolitic rocks present a very characteristic appearance in the field. Due to their resistance to weathering, the nodules stand out as rounded prominences. In fresh specimens, the colour of the rock is uniformly grey, and it is sometimes difficult to decipher the variolitic structure. But, when altered the nodules remain grey or bleach somewhat whitish, whereas the matrix rock turns slightly brownish, and so the contrast is heightened, and the structure is very clearly seen.

The nodules, which are usually about quarter to half inch and rarely one inch in diameter, are quite compact, and often drop out leaving smooth-walled cavities which resemble vesicles. A radial structure is sometimes discernible in the nodules (Fig. 1). In rare cases a concentric zoning can be seen (Fig. 2).

Under the microscope the borders of the varioles are often seen to be demarcated by specks of leucoxene or iron ore. A well-marked radial texture is not clearly visible, but interlocking sheaves can sometimes be seen. Sometimes the nodules are composed of numerous radial groups of crystals not giving perfect black extinction crosses, but only irregular dark brushes. The pyroxenes are almost completely altered, leaving an aggregate of fibrous amphibole. Tiny crystals of pale green amphibole are also found. The original feldspars are rarely seen. Epidote, zoisite and clinozoisite



1



2



3

FIG. 1. Variolite, about 1 mile south of Ingladhah. On the left, several varioles have dropped off leaving smooth-walled depressions. In the centre of the specimen, the varioles exhibit a crude radial structure.

FIG. 2. Variolite, about  $\frac{1}{2}$  mile north of Kurubarmaradikere. The specimen is somewhat altered and the light coloured varioles are clearly seen. A concentric structure is visible in some.

FIG. 3. Variolite from road-cutting near Kunchiganhal. The varioles are large in size and many of them are compound.

are abundantly developed. An irresolvable glassy base full of minute dark specks is present. Thin irregular veins composed of microcrystalline aggregates of quartz and feldspar are seen traversing both nodules and rocky matrix.

Two chemical analyses of these variolitic traps were made by Sri B. Sadasiva Raju, Chemist, Mysore Geological Department. The analyses were made on samples dried at 105°C. The weight percentages are given in Table I and the normative values in Table II.

TABLE I  
Weight percentages

	1	2
SiO <sub>2</sub>	53.08	54.03
Al <sub>2</sub> O <sub>3</sub>	12.48	13.22
Fe <sub>2</sub> O <sub>3</sub>	0.48	2.19
FeO	9.35	8.75
MgO	8.84	7.34
CaO	8.94	8.36
Na <sub>2</sub> O	2.00	2.45
K <sub>2</sub> O	1.97	2.75
H <sub>2</sub> O	2.14	1.89
TiO <sub>2</sub>	1.50	0.01
P <sub>2</sub> O <sub>5</sub>	tr	0.04
MnO	..	..
Total	100.78	101.03
Specific gravity	3.05	3.08

TABLE II  
Norms

	1	2
Quartz	0.48	..
Orthoclase	11.67	16.12
Albite	16.76	20.43
Anorthite	18.90	17.23
Diopside	20.38	19.57
Hypersthene	26.53	20.89
Olivine	..	1.14
Magnetite	0.69	3.24
Ilmenite	2.88	0.15
Apatite	..	0.10

Potash is higher than soda in the second analysis and this is reflected in the normative content of 16.12 per cent. of orthoclase. The thin microcrystalline acid veins traversing these rocks probably contain orthoclase; but its presence has not been definitely determined. In chemical composition, these variolites show great differences from the Jogimardi traps.<sup>4</sup>

1. Sampat Iyengar, P., *Rec. Mys. Geol. Dept.*, 1905, 6, 78. 2. Pichamathu, C. S., *Half-Yearly Journ. Mys. Univ.*, 1930, 4, 10. 3. —, *Curr. Sci.*, 1950, 19, 110-111. 4. —, *Half-Yearly Journ. Mys. Univ.*, 1930, 4, 5.

### INTERNATIONAL CENTRE OF TYPE CULTURE

THE "Centre de Collections de Types Microbiens", at 19, rue Gesar-Roux, Lausanne (Switzerland), keeps an index of microbes and viruses cultivated in the principal bacteriological laboratories in the world. Its latest catalogue thus contains appropriate references to 9,000 different strains which are available on request.

Scientists requiring cultures of strains not

available in their own country may obtain them on direct application to the Centre which will then arrange for the order to be executed by the appropriate laboratories. Through the services of the Centre, the UNESCO Science Co-operation Offices have been able to assist in the past large numbers of research workers in all parts of the world.

### INDIAN DAIRYMAN

THE INDIAN DAIRY SCIENCE ASSOCIATION, who have recently taken over the entire responsibility of publishing the *Indian Dairyman*, must be congratulated on the improvements effected in the format and contents of the Journal. Nearly double its former size, the March issue of the Journal contains many interesting features among which the article

on "Indigenous Milk Products of India" by K. K. Iya and H. Lakshminarayana, deserves special mention. A "Questions and Answers" column has also been opened, which should prove of interest to dairymen in general.

Our heartiest good wishes for the future progress of the Journal, devoted to the popularisation of Dairy Science.



## WHERE DO THEOSOPHY AND SCIENCE MEET ?\*

UNDER the able guidance of Prof. Kanga, many contributors and monographists have collaborated to give us a comprehensive survey of the achievements of modern science and have endeavoured to locate and specify where exactly Theosophy and Science meet.

The war-weary and science-saturated world is to-day unhappy, notwithstanding the phenomenal advancement in values and conditions of civilized life. If a braver and newer world is at all to emerge, it is clear that the peace, joy and bliss of the spirit described in Theosophy and Vedanta should be recaptured and reproduced in concrete life. Technological living and civilization should be founded and re-oriented on a truly spiritual basis. The whole personality of man should be trained and developed. Such are the cardinal conclusions argued and established in the volume under notice.

Part III of Volume II entitled 'God', contains fourteen contributions. Part IV entitled 'Law' has sixteen. While it is not difficult to understand the significance of the title 'Law' (as many of the contributions deal with principles, theory and practice of modern law), the part bearing the title 'God' is rather intriguing. As it is, the part stands devoted to the discussion of psychology, psychical research, anthropoogy and mythology, and no contributor has focussed attention on the special or distinctive problem of God, with reference to the scientific and philosophical arguments for and against the existence of God and connected problems.

For obvious reasons, it is not possible to single out this or that individual contribution for special commendation, as all maintain a high standard of scientific exposition and research. Nevertheless, it can be said that Swami Sivananda's contribution on Yoga (pp. 230-254) would be found particularly illuminating, with special reference to Yoga methodology and practice. The contribution clears up many of the Western misconceptions about the technique and goal of Yoga, and points out that Yoga is neither a sort of magic nor self-hypnotism, but constitutes really a carefully planned out system of psycho-physical practices, whose goal is nothing short of holy communion with Divinity in all its supremacy and splendour. But it seems to us that his dictum that 'Yoga is for all' is to

make the goal seem a little too easy of reach by every one.

The contribution on "Astrology (pp. 379-395) by Charles E. Luntz, it is to be feared, betrays some confusion. The earlier part is contradicted by the latter, in which, however, the author expresses the hope that astrology would be accorded recognition like psychology, in due course.

The English rendering of the Sanskrit verse on page 549 is grammatically incorrect.

When all is said and done, there still remains the big question why Theosophy should seem so anxious to meet Science? Is it nervous or lacking in self-confidence? Or, is there any universal dictum that recognition by Science alone is the hall-mark of academic respectability?

For, it can argumentatively be established that Vedanta, Vedantic methodology and Vedantic experiences commence just where the experimental sciences end and where their jurisdiction terminates. Theosophy must be prepared to take such a stand, or abandon any claim to be recognised as a system of philosophy, leading to Self-Realisation.

In the opinion of the reviewer, science should grow more scientific and theosophy should grow more theosophical, while a meeting should not be forced between the two.

None of these comments, however, would in any manner affect the general excellence of Prof. Kanga's achievement. Prof. Kanga and other contributors may indeed be said to have rudely shaken international complacency, and pointed out clearly that unless concerted attempts are made to eliminate poverty, disease, unemployment, racial bias and inequalities, the crash of contemporary civilisation is rather inevitable. The "Epilogue" contributed by the Editor is a remarkably fine performance. His call to modern men and women to build our civilization anew on a truly spiritual basis, we are sure, will not fail to evoke a generous response from one and all; for the measure of response to such a call would also be an index of whether there is at all any future for our civilization.

Prof. Kanga and his associates are unreservedly to be felicitated on the publication of this volume which is bound to stir and stimulate international thought as preparatory to the much to be desired spiritual reawakening of mankind.

R. NAGARAJA SARMA.

\* Where Theosophy and Science Meet—Edited by D. D. Kanga. Vol. II. The Adyar Library, Adyar, Madras. Pp. xl plus 610. Price Rs. 15.

# LETTERS TO THE EDITOR

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## ENERGY OF AN ISOLATED FLUID SPHERE

THE energy within a definite fixed spatial volume in a gravitational field is given by a well-known integral whose integrand contains certain pseudo-tensor quantities.<sup>1</sup> In using this integral to calculate the energy within a sphere  $r=R$  in a gravitational field described by a line-element of the form

$$ds^2 = -e^{\alpha} dr^2 - r^2 e^{\beta} (d\theta^2 + \sin^2 \theta d\phi^2) + e^{\gamma} dt^2, \\ \alpha = \alpha(r, t), \beta = \beta(r, t), \gamma = \gamma(r, t) \quad (1)$$

one has to evaluate these pseudo-tensor quantities in terms of the "Cartesian" co-ordinates  $x, y, z$ . Again, the radius  $R$  of the sphere has to be a constant. On transforming the co-ordi-

nates  $(r, \theta, \phi)$  of (1) to  $(x, y, z)$  by the usual substitutions one finds that

$$ds^2 = -e^{\beta} (dx^2 + dy^2 + dz^2) - \frac{e^{-\beta}}{r^2} (r dx + y dy + z dz)^2 + e^{\gamma} dt^2 \quad (2)$$

We have evaluated the integral for the energy for the field described by (2) and have found it to be given by

$$U = \frac{1}{2} [e^{(\gamma-\alpha)/2} r e^{\beta} (e^{\alpha-\beta} - 1 - r \partial \beta / \partial r)]_0^R \quad (3)$$

We have also found that (3) will continue to represent energy even when  $R$  is not a constant, but any function of  $t$ .

Generally  $\alpha, \beta, \gamma$  are assumed to be continuous functions of  $r$  and  $t$  everywhere in the field. It will be very satisfying from the physical point of view, to have the expression (3) for

the energy of the sphere  $r=R(t)$  to be a continuous function of  $R$  in the field. In that event  $\partial\beta/\partial r$  should be a continuous function of  $R$  for all values of  $t$ .

Vallabh Vidyanagar,  
Anand,  
January 28, 1952.

P. C. VAIDYA.

1. Tolman, R. C., *Relativity, Thermodynamics and Cosmology*, 1934, p. 227.

### EQUATIONS OF FIT FOR SPHERICAL DISTRIBUTIONS

SEVERAL authors have discussed the equations of fit over a surface of discontinuity, say  $r=a(t)$ , in a gravitational field described by a line-element of the form

$$ds^2 = -e^{\alpha} dr^2 - r^2 e^{\beta} (d\theta^2 + \sin^2 \theta d\phi^2) + e^{\gamma} dt^2, \\ \alpha = \alpha(r, t), \beta = \beta(r, t), \gamma = \gamma(r, t) \quad (1)$$

Generally the co-ordinates  $r$ ,  $t$  and the coefficients  $\alpha$ ,  $\beta$ ,  $\gamma$  of the metric are assumed to be continuous over all such boundaries of the field. But different authors have postulated different behaviours for the first derivatives of  $\alpha$ ,  $\beta$ ,  $\gamma$  over  $r=a(t)$ . Lemaitre<sup>1</sup> has used a line-element of the type (1) with  $\beta=0$  and has postulated the continuity of only one derivative, viz.,  $\partial\gamma/\partial r$ , over the boundaries of the field. Einstein and Strauss<sup>2</sup> have again used a line-element of the type (1) but with  $\alpha=\beta$ , and have assumed the continuity of  $\partial\alpha/\partial r$  and  $\partial\gamma/\partial r$  explicitly, while the continuity of  $\partial\alpha/\partial t$  and  $\partial\gamma/\partial t$  occurs implicitly in their calculations. Recently Clark<sup>3</sup> has postulated the continuity of all the first derivatives of  $g_{\mu\nu}$ .

We have studied this problem of the equations of fit for fields described by (1) and our conclusions are: (i) in addition to the usual continuity of  $r$ ,  $t$  and the functions  $\alpha$ ,  $\beta$ ,  $\gamma$ , it is necessary that  $\partial\beta/\partial r$  be a continuous function throughout the field described by (1); (ii) the other first derivatives of  $\alpha$ ,  $\beta$  or  $\gamma$  need not be continuous everywhere in the field. As a matter of fact, their behaviour over any surface of discontinuity in the field cannot be postulated but is determined by the physical properties of the gravitational situations under consideration.

As already mentioned elsewhere<sup>4</sup> the continuity of the function  $\partial\beta/\partial r$  is necessary to ensure that the function representing the energy of a sphere of radius  $R(t)$  in the field is a continuous function of  $R$  for all values of  $t$ . We have now worked out a general solution for the gravitational field of a star which illustrates the conclusion (ii) above, different situations within the star demanding different behav-

iours for the other first derivatives of  $\alpha$ ,  $\beta$  or  $\gamma$ . This solution and other details will be published elsewhere.

Vallabh Vidyanagar,  
Anand,  
January 28, 1952.

P. C. VAIDYA.\*

\* Springer Research Scholar, University of Bombay.

1. Lemaitre, A. G., *Mon. Not. Roy. Astro. Soc.*, 1931, 91, 493.
2. Einstein and Strauss, *Rev. Mod. Phys.*, 1945, 17, 120.
3. Clark, G. L., *Proc. Roy. Soc. Edin.*, 1, 1949, 62, 429.
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### MAGNETIC SUSCEPTIBILITY OF MIXED CRYSTALS OF POTASH AND CHROME ALUMS

THE constituents of the mixed crystals that were the subject of study here, are potassium alum  $[KAl(SO_4)_2 \cdot 12H_2O]$  and chrome alum  $[KCr(SO_4)_2 \cdot 12H_2O]$  one of which is diamagnetic and the other paramagnetic.

The mixed crystals were prepared by dissolving the two alums in water in various proportions. The concentration of each specimen studied was determined by chemical analysis as it had no relationship with the concentration of the solution from which the crystals were grown. Susceptibilities of the mixed crystals were determined by the Oxley<sup>1</sup> balance.

Table I contains the results. Here  $\chi$  represents mass susceptibility while  $\chi_M (\chi \times M)$  is the gram molecular susceptibility.  $M$ , the molecular weight of the mixed crystal, is taken to be  $M_1 M_2 / [M_2 r_1 + M_1 (1 - r_1)]$  where  $M_1$  and  $M_2$  are the molecular weights of the constituent alums and  $r_1$  is the fraction by weight of one of the alums in the mixed crystal.

Percentage of potash alum by weight	$\chi \times 10^6$ observed	$\chi_M \times 10^3$ observed	$\chi_M \times 10^6$ calculated	Difference $\Delta \chi_M$ (obs.-cal.) $\times 10^6$	Percent
1 100	- 0.58	-275.1	..	..	..
2 89.69	+ 0.799	+381.3	327.3	54.0	0.36
3 82.94	+ 1.942	+928.3	724.3	204.0	0.67
4 49.37	+ 7.00	3405.0	2744.0	661.0	1.26
5 45.00	+ 7.82	3812.0	3010.0	802.0	1.39
6 35.5	+ 9.102	4460.0	3598.0	862.0	1.44
7 0	+11.7	5841.0	..	..	..

It will be observed that the susceptibilities do not follow a linear relationship with concentration, but are larger than what is warranted by the linear law ( $\chi$  calculated). The maxi-



mum deviation  $\Delta\chi_M$  was found to be  $879.6 \times 10^{-6}$  at a concentration of 40% of potash alum as read from a graph. In order to understand these results the extraparamagnetic susceptibility was expressed in terms of Bohr magnetons per an ion of chromium by means of the formula.

$$P_{\text{EXCESS}} = \frac{\sqrt{3}RT(\Delta\chi_M)}{\mu_B}$$

where  $\mu_B$  is the Bohr magneton per gram molecule (5564). The last column gives the Bohr magnetons thus calculated. It looks as if the maximum deformation which the paramagnetic portion of the susceptibility of crystal has undergone is 1.46 Bohr magnetons.

The usual explanation for the observed low paramagnetism of the chromium salt is that the orbital moments are quenched and that the spins alone take part in the paramagnetism. Since the effective magneton number is  $\sqrt{4S(S+1)}$  it becomes in the case of chromium equal to 3.87 where  $S$  is  $3/2$  agreeing with the experimental value 3.82.<sup>2</sup> We have in the present investigation a release of paramagnetism of maximum amount 1.46 Bohr magnetons so that the maximum paramagnetism that the chromium ion can exhibit is  $1.46 + 3.82 = 5.28$ . This indeed agrees with the theoretical value of the effective magneton number obtained from  $\sqrt{L(L+1) + 4S(S+1)}$  equal to 5.21, where  $L$  is equal to 3. Thus it looks as if diluting the paramagnetic substance with a diamagnetic one helps to release the otherwise quenched orbital paramagnetism.

The author is glad to acknowledge that this problem originated from Prof. S. Bhagavantam of the Osmania University. He is thankful to Prof. M. Ramanadham for his guidance.

Physics Department,  
Presidency College,  
Madras,  
February 11, 1952.

V. D. P. SASTRI.

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#### SPACE GROUP OF MAGNESIUM AND SODIUM ACETATES

MAGNESIUM ACETATE TETRAHYDRATE [ $\text{Mg}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$ ] crystallises from aqueous solution at room temperature. The crystals belonging to the monoclinic system were needle-shaped and elongated along the  $c$ -axis. Layer line measurements on  $\text{Cu K}_\alpha$  oscillation photographs taken with the axis of rotation parallel

to each of the three principal axes gave the following lattice constants:  $a = 8.5$ ,  $b = 11.7$ ,  $c = 4.7 \text{ \AA}$  and  $\beta = 94.9^\circ$ . These lead to the ratios  $a:b:c = 0.72:1:0.40$  in good agreement with the previously reported morphological values:  $a:b:c = 0.7128:1:0.403$  and  $\beta = 95^\circ 37'$  (Groth<sup>1</sup>). Taking the density to be 1.453, the number of molecules per unit cell comes out to be 1.96, i.e.,  $Z = 2$ . There were no systematic absences in the reflections  $hkl$ . Hence the unit cell is primitive. A careful study of a complete series of  $c$ -axis oscillation photograph reveals that  $0k0$  is absent when  $k$  is odd, showing thereby the presence of a two-fold screw axis along  $b$ . If Groth's assignment to the prismatic class is accepted, the space group may be  $C_{2h}^{21} - P2_1/m$  or  $C_{2h}^{21} - P2_1/c$ . Oscillation photographs about the  $b$  axis showed no systematic absences in the  $h0l$  reflections. Hence magnesium acetate tetrahydrate must belong to the space group  $C_{2h}^{21} - P2_1/m$  with two molecules per unit cell.

Sodium acetate trihydrate ( $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$ ). Morphological studies show that the crystal class is  $C_{2h}$  with axial ratio  $a:b:c = 1.18:1:0.996$  and  $\beta = 111^\circ 43'$ . This substance also crystallises from aqueous solution with the  $c$ -axis as needle axis. Measurements made with rotation and Weissenberg photographs around the three principal axes yielded the values  $a = 12.4$ ,  $b = 10.5$ ,  $c = 10.3 \text{ \AA}$  and  $\beta = 112.1^\circ$ . These lead to the ratios  $a:b:c = 1.18:1:0.99$ . Assuming the density to be 1.45 (Groth) the number of molecules per unit cell comes out to be 8.02, i.e.,  $Z = 8$ . Zero level and first level equi-inclination Weissenberg photographs about the  $c$ -axis reveal that the only systematic extinction is the absence of  $hkl$  when  $h+k$  is odd. The cell is thus  $C$ -centered. The space group may therefore be either  $C_{2h}^{21} - C2/m$  or  $C_{2h}^{21} - C2/c$ . Zero level Weissenberg photographs about the monoclinic axis  $b$  did not show any systematic absences in the  $h0l$  reflections indicating thereby the absence of a glide plane. Hence the space group must be  $C_{2h}^{21} - C2/m$ . Further investigations are being carried out.

I am grateful to Prof. R. S. Krishnan for his interest in the present work. I am also indebted to Dr. G. N. Ramachandran for his discussions I had with him.

Physics Department, V. M. PADMANABHAN,  
Indian Institute of Science,  
Bangalore,  
March 7, 1952.

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# THE COMPLEX BAND SPECTRUM OF NICKEL BROMIDE

FOLLOWING the work on the band spectrum of nickel chloride published previously,<sup>1</sup> that of nickel bromide has been obtained from  $\lambda$  3,900 to  $\lambda$  5,000 Å. As in NiCl, two  $^4\Pi - ^4\Sigma$  transitions designated as 'α' and 'β' have been identified with a common ground state of vibrational frequency  $\omega_e = 313$ . The wavenumbers of the Q heads as obtained in the (0, 0) sequences of the two systems are:

System	Q <sub>4</sub>	Q <sub>3</sub>	Q <sub>2</sub>	Q <sub>1</sub>
α	24017.9	23906.4	23789.2	23658.1
β	22688.6	22581.5	22461.6	22341.9

Another system is also identified and designated as 'γ'. For this the values of  $\omega_e = 294.9$ ,  $\omega_e' = 317.2$  cm.<sup>-1</sup> and  $\nu_e = 21790.7$  cm.<sup>-1</sup>

Details of the analysis will be published elsewhere.

Dept. of Physics, V. G. KRISHNAMURTY,  
Andhra University,  
Waltair,  
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# A NEW RECORD OF AN EQUISETALIAN CONE FROM RANIGUNJ COALFIELD, INDIA

A CONE compression showing resemblance with the fructifications of the family *Equisetaceae* was found in the shales associated with the coal seams of Ranigunj stage in the Ranigunj Coalfield (West Bengal). Cones of some species of *Equisetites* have been described by Kidston,<sup>4</sup> Halle<sup>3</sup> and Erdtman.<sup>1</sup> Fructifications of *Phyllothea* were described by McCoy<sup>5</sup> from New South Wales and by Zeiller<sup>6</sup> from Asia Minor, while that of *Schizoneura australis* by Etheridge<sup>2</sup> from Australia. So far fructifications of *Equisetaceae* have not been reported from Indian Gondwanas.

This specimen is a compression with carbonised matter still preserved at some places. It is broadly elliptical in outline with rounded apex and a slender stalk at the base (Fig. 1). It measures 30 mm. in length exclusive of stalk and 15 mm. at its widest part. On the surface of the compression are seen polygonal discs closely fitting with one another. These discs

appear to be the peltate heads of the stalked sporangiophores arranged in whorls on the axis. In the centre of the discs are seen circular marks which must have been the points of



FIG. 1. An Equisetalian cone from Ranigunj (actual size)

attachment of the sporangiophores with the peltate heads. Diameter of the polygonal discs is about 2 mm. and that of the circular elevated mark in the centre is about 1 mm. The compression at its broadest part of the short axis bears 5 to 6 polygonal discs and 12 such discs are countable along the long axis of the cone. A detailed description of the cone will be published elsewhere.

I am grateful to Dr. K. R. Surange for the interest he evinced in this work and for his guidance.

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\* These were inaccessible to the author.

# CHLORINATION OF ILMENITE

THE production of titanium tetrachloride by the chlorination of ilmenite is of particular importance to India since this country possesses large deposits of the ilmenite ore. Details of chlorination of titanium dioxide,<sup>1</sup> titanomagnetite,<sup>2</sup> sphene<sup>3</sup> and rutile<sup>4</sup> are given in literature; but, very little information is available on the direct chlorination of ilmenite. Patent literature<sup>5</sup> on the subject indicates that the temperature of chlorination ranges from 600°

to 1,200° C. A systematic work on the chlorination of Travancore ilmenites is undertaken in this laboratory and the following are some of the important features of the investigation:

In the investigations carried out by the present authors, the titanium ore ( $\text{TiO}_2 = 58.9\%$ ,  $\text{Fe}_2\text{O}_3 = 28.3\%$ ,  $\text{FeO} = 5.0\%$ ,  $\text{MnO} = 0.4\%$ ), was crushed to -200 mesh, intimately mixed with pulverized charcoal and chlorinated in a tubular electric furnace. Titanium tetrachloride and ferric chloride formed were condensed in a flask and the uncondensed vapours were absorbed in sodium hydroxide solution. The residue left over in the furnace at the end of the experiment and the products of chlorination were analysed for iron and titanium by a slight modification of the method of Hope and co-workers.<sup>6</sup> In all the experiments, the amount of the mixture to be chlorinated was about 5 g.; the duration of chlorination was one hour and the rate of passing chlorine was 4 litres per hour. The results are given in Tables I to III.

Table I indicates that chlorination for one hour at 600° C. converts 95.6% of titanium dioxide into the tetrachloride but Pamfilov and Shtandel<sup>2</sup> have obtained a yield of 98%

TABLE I

Effect of temperature on chlorination of ilmenite

Amount of carbon added for 100 g. of ore = 60 g

Temp. of chlorination °C.	$\text{TiO}_2$ chlorinated %	$\text{Fe}_2\text{O}_3$ chlorinated %
500	100	100
700	95.8	97.4
600	95.6	90.7
500	92.8	81.3
400	49.9	70.0
300	11.4	38.2
200	nil	nil

TABLE II

Effect of carbon on the chlorination of ilmenite

Temperature of chlorination = 500° C.

Carbon added on the weight of ore in %	$\text{TiO}_2$ chlorinated %	$\text{Fe}_2\text{O}_3$ chlorinated %
60	92.8	81.3
50	93.6	86.0
40	92.5	89.1
30	89.8	90.9
20	84.0	92.7
10	42.3	96.8
7	7.6	89.5

TABLE III

Effect of various catalysts on the chlorination of ilmenite

Amount of carbon added for 100 g. of ore = 30 g.

Amount of catalyst added for 100 g. of ore = 1 g.

Temperature of chlorination = 400° C.

Catalyst used	$\text{TiO}_2$ chlorinated %	$\text{Fe}_2\text{O}_3$ chlorinated %
Pyrites (Fe)	60.0	70.0
$\text{MnO}_2$	62.4	77.2
$\text{CuO}$	73.2	86.7
$\text{PbO}$	74.9	84.5
$\text{Ca}_3(\text{PO}_4)_2$	76.6	83.2
$\text{CeO}_2$	81.3	89.0
Without catalyst	49.9	70.0

by chlorinating titanomagnetite for six hours under similar conditions. Table II indicates that 30% of carbon on the weight of ilmenite is optimum for total chlorination of ilmenite. The study on the effect of catalysts on the chlorination indicates that the chlorination can be effectively carried out even at 400° C. under optimum conditions; while the temperature given in literature ranges from 600° to 1,200° C. The reduction of chlorinating temperature is of very great importance since high temperature favours the corrosion of the equipment by the chlorine gas. Details of the work will be published elsewhere.

Our thanks are due to Dr. B. Sanjiva Rao for suggesting the problem.

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Bangalore-3,  
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#### PRELIMINARY NOTE ON METHIONINE EXCRETION IN LATHYRISM

TWENTY-FOUR hours Methionine excretion in 24 normal persons and 22 lathyrism cases who were still consuming *L. sativus*, has been estimated

by the method of Albanese, et. al.<sup>1</sup> The values are given in Table I. When the patients give up taking *L. sativus* and substitute it by other pulses the methionine excretion immediately rises (Table I). The standard deviation indi-

	No. of cases	Methionine Excretion (mg./24 hrs.)
1. Normal	21	447 ± 120
2. Lathyrism (taking <i>L. sativus</i> )	22	84 ± 47
3. Lathyrism (given up <i>L. sativus</i> )	6	379 ± 106

Statistical analysis of 1 & 2 :

$$t = 139.7; p = < .01.$$

cates the wide distribution of the excreted methionine which is not unexpected. The decreased excretion in lathyrism is due to a toxic factor present in *L. sativus* which is under investigation.

We are aware that the Albanese method gives much higher methionine values in urine than the microbiological method. We are inclined to agree with Tomich<sup>2</sup> that this may be due to conjugation of methionine with some factor, rendering it unavailable to the assay organism.

In lathyrism, the methionine excretion falls because a structural change takes place due to the toxic factor present in *L. sativus*.

The experimental data were completed in May, 1950. We are indebted to the Bihar Board of Medical Research for a Junior Research Fellowship to one of us (L.M.C.)

Dharbhanga Medical College,

Laheriasaral,

Bihar,

March 10, 1951.

M. N. RUDRA.

L. M. CHAUDHURY.

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#### NITROGEN AND PHOSPHORUS ABSORPTION BY WHEAT

THE relationship between the utilisation of nitrogen and phosphorus by plants has been worked out by a number of investigators.<sup>1,2,3,5,6,7</sup> In our field experiment, nitrogen was applied in different forms of organic manures and inorganic combinations and phosphate was applied either alone or with potash as well. The wheat crop during 1942-43 followed maize and jowar in kharif and in general the nitrogen available was poor as shown by low nitrogen recoveries.

The wheat crop during 1943-44 was after fallow and general nitrogen availability was more as shown by substantial nitrogen recoveries. The ratios of nitrogen and phosphate uptake by wheat varied from 1.64 to 1.89 under different treatments while the same were as high as 2.51 to 2.88 in 1943-44. The work of Subbiah<sup>8</sup> and Desai and Subbiah<sup>4</sup> on cation anion relationships in plants indicates that, being on the anion side the absorption of nitrogen and phosphate would be governed by their relative availability at the time of growth. This would explain the present observation that by fallowing increased uptake of nitrogen has taken place at the expense of phosphate.

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New Delhi,

S. V. DESAI.

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#### SOIL PERMEABILITY

VARIOUS aspects of soil permeability have been studied by previous workers.<sup>1,3,4,5</sup> But, the effect of temperature of dehydration of the soil on the permeability changes with time has not been studied so far. A study of this aspect of subject has revealed interesting features.

The Gangetic alluvial soil of Delhi (India) was chosen for the study. Permeability measurements were carried out by employing the vertical tube permeameter and adopting the constant water-level arrangement. The soil was dehydrated at 60° C., 150° C., 225° C., 360° C., 600° C., 800° C. and 1,000° C. The permeabilities of each one of these dehydrated soils, along with those of the normal soil at room temperature (about 30° C.) have been measured at 35° C. in a thermostat. The changes in permeability with time have been indicated in Fig. 1.

The common features of the permeability-time curve of any soil are, the initial decrease of the permeability to a minimum, the subsequent increase to a maximum and the final decrease which is a slow and continuous process.<sup>1,3,4</sup> All these changes are normally exhi-

bited when the soil is under prolonged submergence in water.

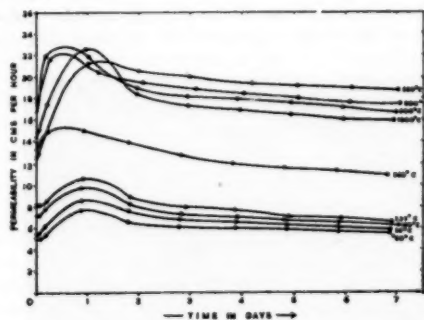


FIG. 1. Permeability of soils dehydrated at different temperatures.

All the soil samples dehydrated at the different temperatures retain the above features. But the permeability-time curve shows a lateral shift with the progressive increase in the temperature of dehydration of the soil. The soil dehydrated at 60° C. suffers a decrease in permeability. With further increase in the temperature of dehydration upto 650° C. the permeability steadily increases. Above 650° C., the soil suffers a decrease in permeability. Between 650° C. and 1,000° C., the reproducibility of the permeability-time curve becomes less accurate.

The permeability of a soil for water is essentially a capillary flow phenomenon. Of the total porosity of a soil, it is the non-capillary porosity (wider porosity) that is believed to be responsible for the permeability, whereas the capillary porosity (finer porosity) determines the water-holding capacity.<sup>2</sup> The increase in permeability with increase in the temperature of dehydration of the soil from 60° C. to 650° C. indicates an increase in the non-capillary porosity, i.e., of the wider pores. Wider pores can be produced by the increase in the size of the soil particles. It follows then that higher temperatures facilitate the aggregation of the smaller soil particles into bigger particles. This mechanism is quite probable in view of the high temperature of dehydration.

When the normal soil is dehydrated at 60° C. there is however a small decrease in permeability. This decrease indicates that the soil suffers a small shrinkage on dehydration. As a result of this shrinkage, the porosity decreases and consequently the permeability also decreases.

The decrease in permeability when the tem-

perature of dehydration is raised from 650° C. to 1,000° C. indicates a decrease in total porosity, and this is probably due to a certain amount of incipient fusion of soil particles at the high temperature, resulting in a decrease of the porosity.

The above mechanism of the changes taking place in the soil when the soil is subjected to dehydration at higher temperatures is very interesting indeed. Low temperatures of dehydration like 60° C. bring about only the shrinkage of the soil reducing the porosity whereas high temperatures upto 650° C. bring about aggregation of the smaller soil particles into bigger aggregates. Above 650° C. the soil seems to suffer an incipient fusion resulting in a decrease of the porosity.

The authors are grateful to Dr. D. S. Kothari for evincing keen interest in the work.

K. SUBBA RAO.

S. K. WADHAWAN.

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#### THREONINE IN BENGAL GRAM

In an investigation on the excretion of amino acids in urine in relation to age, rats have been maintained on a vegetable protein diet in which the protein was solely contributed by Bengal gram (*Cicer arietinum*). The composition of the diet was as follows: Starch 26.5 parts, Bengal gram 48.5 parts, Sugar 11 parts, Oil 10 parts, Salt mixture 4 parts. The rats received in addition, vitamins A and D and crystalline vitamins of the B complex in adequate doses. As shown later, the rats on this diet did neither show a negative nitrogen balance, nor any impairment of growth.

Lal<sup>1</sup> has recently reported the absence of threonine in Bengal gram. Wolf and Corley<sup>2</sup> have reported that the amino acid threonine is essential for the maintenance of a positive nitrogen balance and this observation has been further confirmed by Burroughs, et al.<sup>3</sup> Rose<sup>4</sup> in 1930 observed that when a mixture of 19 of the then known component amino acids of protein was incorporated in the ration of young rats as the sole source of nitrogen rapid losses



of weight occurred and later Meyer and Rose<sup>5</sup> found that the inclusion of threonine brought about comparatively rapid gains in weight. Thus a diet containing Bengal gram as the sole source of protein should have resulted in a negative nitrogen balance and also impairment of growth if it was lacking in threonine.

Nitrogen balances were determined every month on the diet described above. Table I contains the relevant data for a period of six months. At no period was a negative nitrogen balance obtained. The rats were also weighed every week and the growth curve illustrated in Fig. 1 makes it clear that no loss of weight

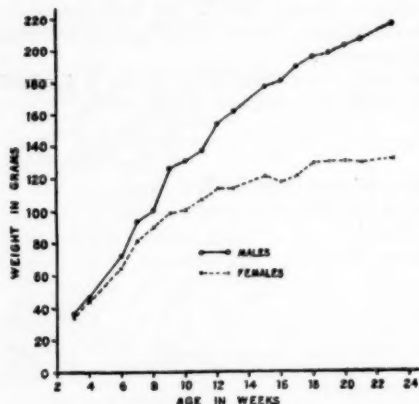


FIG. 1. Growth curve on Bengal gram diet.

occurred on the Bengal gram diet. These results thus prove that Bengal gram does not lack in any of the essential amino acids including threonine.

TABLE I

Age in months	Intake of nitrogen in mg.	Urine nitrogen in mg.	Faecal nitrogen in mg.	Balance in mg.
1	118.2	23.6	17.1	+77.5
2	145.7	65.2	30.6	+49.9
3	150.3	53.0	36.2	+61.1
4	159.6	72.1	31.2	+56.3
5	178.7	71.1	46.1	+61.5
6	173.7	100.5	52.0	+21.2

The presence of threonine in Bengal gram was confirmed by paper partition chromatography of a sulphuric acid hydrolysate of defatted Bengal gram. The method employed was essentially that of Dent<sup>6</sup> using phenol-water and collidine-water as the solvents. The chromatogram (Fig. 2) clearly shows the presence

of threonine in Bengal gram. The addition of a few  $\gamma$  of threonine to the hydrolysate resulted in a chromatogram with an intense spot at the place marked '5' in Fig. II, thereby confirming that the original spot '5' was due to threonine.

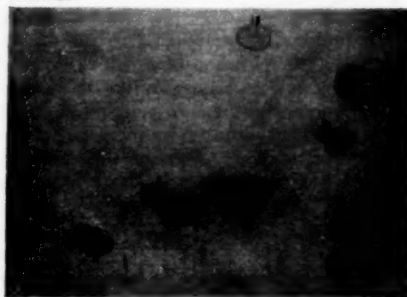


FIG. 2. Chromatogram of Bengal Gram Hydrolysate.

1. Aspartic acid. 2. Glutamic acid. 3. Serine. 4. Glycine. 5. Threonine. 6. Alanine. 7. Lysine. 8. Arginine. 9. Histidine. 10. Proline. 11. Valine. 12. Methionine, Phenylalanine, Leucine and Isoleucine. 13. Tyrosine.

Quantitative assessment of threonine by microbiological assay was carried out using *S. fecalis* R. (A.T.C.C. 8043) as the test organism. The general technique employed for the assay was similar to that described by Dunn, *et al.*<sup>7</sup> The threonine content of Bengal gram based on the results of three assays was found to give an average value of 8.10 g. per 100 g. of protein with a range of 7.95 to 8.22 g. The average recovery of threonine in parallel assays was 103.5 per cent.

The minimum level of threonine which is capable of supporting optimum growth in the weanling rat has been recently reported by Rose, *et al.*<sup>8</sup> to be 0.5 per cent. of the diet. Benditt, *et al.*<sup>9</sup> have established the amount of threonine essential for maintenance as 85 mg. per kilogram of body weight. Considering the amount of threonine present in Bengal gram, it is evident that the level is sufficient for growth and maintenance. This is in agreement with our observations on growth and N-balance of rats fed Bengal gram as the sole source of protein.

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### SYNTHESIS OF SOME POTENTIAL ANTIMYCOBACTERIAL AGENTS

On the assumption that permeability constitutes the limiting factor in the potency of the known antimycobacterial agents such as *p*-aminosalicylic acid, streptomycin and sulfones,<sup>1</sup> a number of asymmetric diaminodiphenyl sulfones have been prepared with a view to include in the molecular architecture biologically stable groupings, that would confer upon the molecule an optimal fat water solubility ratio without materially interfering with its antibacterial activity. Such a molecule would be expected to penetrate to the site of action with greater ease.

The compounds have been so modelled as to carry a lipophilic alkyl chain at one of the nitrogen atoms, and a sugar, as the hydrophilic equilibrating moiety, at the other nitrogen. Galactose has been selected because it is known to be one of the few sugars that have comparatively little intercellular permeability impediments even though highly lipid insoluble.<sup>2</sup> The alkylamino linkage is expected to resist bio-cleavage, whereas galactose may split and the lipid soluble drug emerge at the site of infection with the requisite one free phenylamino group in the sulfone molecule.

TABLE I



No.	R	Analysis % N		(α) <sub>D</sub> <sup>25</sup> in MeOH
		Required	Found	
1	Ethyl <sup>c</sup>	6.39	6.60	-20.0 ± 2
2	Propyl <sup>d</sup>	6.19	6.29	-18.0 "
3	n-Butyl <sup>c</sup>	6.00	5.50	-11.5 "
4	Isobutyl <sup>b</sup>	6.00	5.91	-15.0 "
5	n-Amyl <sup>b</sup>	5.80	5.63	-11.5 "
6	Isomyl <sup>d</sup>	5.80	5.50	-11.5 "
7	n-Hexyl <sup>a</sup>	5.66	5.37	-11.5 "
8	Octyl <sup>a</sup>	5.35	5.00	-12.0 "
9	Lauryl <sup>a</sup>	4.85	4.67	-13.0 "

Table I indicates the various end-compounds synthesised and their requisite data. The *p*-alkylamino-*p*'-aminodiphenyl sulfones were prepared by a slight modification of the method used by Baker, Querry and Kadish<sup>3</sup> and these were converted into the corresponding galactosides by Kuhn and Strobel's procedure<sup>4</sup> using ammonium chloride as a catalyst. The galactosides do not have definite melting points but decompose over a range; the corresponding free amines, however, have very sharp melting points.

(a) Crystallised from methanol; (b) Crystallised from aqueous methanol; (c) Crystallised from water; (d) Could not be crystallised and were obtained as colourless amorphous powders.

Biological screening of these compounds and further syntheses along the above lines, as also of the corresponding sulfides, sulfoxides and thiosulfates, are in progress. Preparative and biological data and other details will be published elsewhere.

Central Drug Res. Inst.,  
Lucknow,  
March 3, 1952.

G. N. VYAS.  
NITYA ANAND.  
M. L. DHAR.

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### OCCURRENCE OF *LERNEENICUS* SP. ON *SCOMBER SCOMBER*. LAWSON'S BAY, WALTER

A SINGLE female was collected attached to *Scomber scomber*. The head and trunk of the parasite were deeply embedded in the body of the fish with only the bright red egg strings protruding behind. Dissection revealed the head lobes in actual contact with the vertebral column of the host. When removed the head was found to be yellowish with a slight blackish tint, the trunk of flesh colour and the egg strings bright red. The head is triangular with three posterior short conical lobes. The short neck merges with the trunk which is annulated and the egg strings which protrude behind are as long and of the same diameter as the trunk. The entire length of the body is 45 mm.

That it is *Lerneenicus* is shown by the fact that the head is triangular provided with three short knobs and is placed at right angles to

the thorax.<sup>2</sup> Specific identity could not be determined for want of more material.

My thanks are due to Prof. R. Gopala Aiyer for having kindly gone through this note.

Zoological Labs., T. S. SATYANARAYANA RAO.  
Andhra University,  
Waltair,  
November 12, 1951.

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### A DILATOMETRIC STUDY OF THE SOYBEAN INHIBITORS

WITH the identification and isolation of proteolytic inhibiting substance present in soybeans by Ham, *et al.*,<sup>1</sup> considerable interest has been evinced on the role of this inhibitor in protein nutrition.

In the experiments reported here, the course of digestion was followed by a three-bulbed dilatometer. The procedure employed was the same as recommended by Srinivasaya and Bhagavat.<sup>2</sup> The substrate (1% casein in sodium hydroxide-phosphate buffer, pH 8.0), enzyme (1% trypsin in the same buffer, proportion of substrate to enzyme being 20:1), and inhibitor\* (also at the same pH) were placed separately in the three bulbs of the dilatometer. When the solutions had attained the temperature of the thermostat (37° C.) as indicated by a constancy (within the normal permissible limits) of the fluid level in the capillary, the solutions were mixed.†

The level was recorded during the progress of digestion. A control was also run under identical conditions. Amino nitrogen release was recorded in both cases (Table I).

TABLE I  
Release of Amino Nitrogen

Serial No.	1	2	3	4	5	6	7	8	9	10
Time in minutes	0	15	30	45	60	90	120	150	180	240
Amino Nitrogen in control (mgm.)	0.5	5.8	7.5	9.7	10.6	12.4	13.7	14.6	15.5	16.0
Amino Nitrogen in experimental (mgm.)	0.9	5.9	6.0	5.7	5.0	5.9	6.9	6.0	7.0	8.6

\* Inhibitor was obtained by extracting raw soybeans with hydrochloric acid at pH 4.2. The extraneous protein present was removed by papain digestion.

The results indicate a fair amount of correlation between amino nitrogen released and the dilatometric readings (Fig. 1). While in the control series, there is a gradual and smooth breakdown as shown both by an uninterrupted drop in the toluene level (Fig. 1) and by a

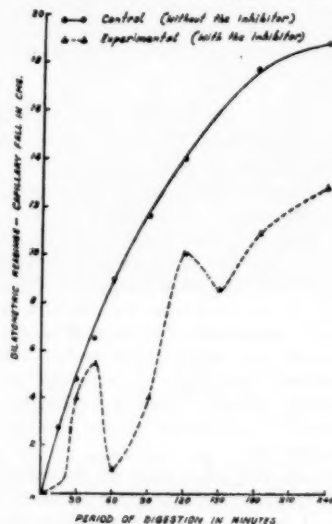
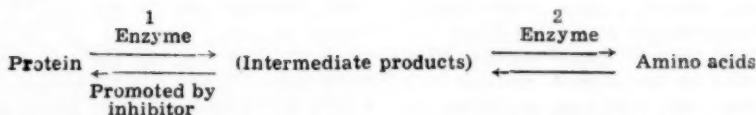


FIG. 1

steady increase in the amino nitrogen, in the experimental series toluene level has registered a fall and rise. The amino nitrogen released confirms the above. These data, therefore, suggest a disaggregation of the colloidal protein and aggregation of the breakdown products thereof under the influence of the inhibitor.

In addition to the above a number of other controls were also run under identical conditions—inactivated inhibitor (by heat treatment) + enzyme + substrate, inactivated enzyme + inhibitor + substrate, and inhibitor +

† The initial volume change, consequent on mixing the reactants was taken note of and necessary correction for this was applied.



enzyme only and due corrections for these were applied for obtaining the final results.

In other studies the inhibitor has been shown to be an anti-proteinase of trypsin having very little action on the peptidase activity of the enzyme (results under publication). The influence of the inhibitor after definite stages of pretryptic digestion was studied and these observations have shown that the percentage inhibition after 2 hrs. of predigestion is considerably higher than one hour predigestion. Under normal conditions, one should expect an increased digestion after two hour predigestion period as compared to one-hour predigestion period. These considerations therefore suggest that a certain concentration of peptides is necessary for the reverse reaction to proceed under the influence of the inhibitor. On the basis of this inhibitor action on predigested proteins, it is postulated that the inhibitor may act by facilitating an aggregation of the intermediate products—likely a resynthesis—of the protein by shifting the equilibrium backwards at Stage 1 as indicated above.

The detailed paper will be published elsewhere.

Our thanks are due to Dr. S. S. De and Dr. K. V. Giri for their keen interest and helpful suggestions in these investigations.

Dept. of Biochemistry, T. VISWANATHA.  
Ind. Inst. of Science, R. RAJAGOPALAN.  
Bangalore-3,  
January 29, 1952.

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#### OCCURRENCE OF UNPAIRED OVARY IN ONITIS DISTINCTUS LANSB.

THE occurrence of paired ovaries is a common feature among insects. Amongst the Apterygota, in Thysanura, there are two ovaries each having five to seven ovarioles. Amongst the Pterygota, two ovaries occur in the primitive order like Orthoptera as well as in the higher orders like Hemiptera, Diptera and Coleoptera. The primitive number of ovarioles is probably never more than eight, this number being retained by *Periplaneta*, a representative of the most primitive Pterygote order, Orthoptera.

While dissecting *Onitis distinctus* Lansb. (Coleoptera-Scarabaeidae), the common dung roller, it was noticed that there was only one ovary having a single ovariole convoluted like the letter 'S'. It lies asymmetrically a little towards the left and extends from the first visible abdominal segment to the fourth. The average size of the ovariole is 14.8 mm.  $\times$  0.68 mm.

The occurrence of a single ovary with only one ovariole is a common feature in certain Aphididae (Hemiptera) where it is a case of specialisation by reduction, but in Coleoptera it is a very unusual feature. Tanner<sup>1</sup> as a result of his study of the genitalia of sixty-seven Coleopteran families considered Scarabaeidae to be the most specialised family. The occurrence of single ovary with only one ovariole in *Onitis distinctus* Lansb. is another instance of specialisation in the family Scarabaeidae.

Zoology Department, P. D. SRIVASTAVA.  
University of Allahabad,  
Allahabad,  
January 10, 1952.

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#### OCCURRENCE OF THE LIMBLESS LIZARD BARKUDIA ANNANDALE AT WALT AIR

THREE genera of limbless lizards, *Barcudia* Annandale and *Nessia* Grey of the family Scincidae and the third *Ophisaurus* Daudin of the family Anguillidae, have so far been reported from India.<sup>1</sup> The genus and the type species *Barkudia insularis* was created by Annandale in 1917 for a form which he dug out from loose earth at the root of a banyan tree on the Barkuda Island in the Chilka lake.<sup>2</sup> A second specimen was collected in 1919 by Dr. F. H. Gravely from the same locality. Apart from these two specimens we are not aware of any other record of this species from India.

Limbless lizards belonging to the genus *Barkudia* Annandale are fairly common in the Andhra University Campus at Waltair and the immediate environs. The first specimen was collected by one of us in July, 1949. The animal lives buried in the sub-soil and they are more abundant in the surface layers immediately

after the rains. With the onset of dry weather they are comparatively rare, presumably because they burrow into deeper regions. From an examination of the stomach contents it is clear that they feed mostly on centipedes, insect larvæ, etc. The animal is an efficient burrower and it needs great care to dig them out entire.

Our collections from Waltair and its environs have convinced us that there are two distinct forms of the genus here, both differing from the type description for *Barkudia insularis* Annandale.

A detailed account of the systematics, bionomics, anatomy and life-history of the local forms are in progress and will be published in due course.

Department of Zoology, P. N. GANAPATI.  
Andhra University, K. KRISHNAN NAYAR.  
Waltair,  
February 21, 1952.

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#### ON THE TUBULAR OVA OF THE SOUTH INDIAN RODENT *BANDICOTA* *MALABARICA*

In polyovular mammals like the rabbit, rat, mouse, ferret, etc., the penetration of the ova by sperms results in the falling away of the follicle cells.<sup>1</sup> Other investigators like Yamane<sup>2</sup> have also observed this phenomenon in the rabbit and it has been experimentally shown by Gilchrist and Pincus in the rat.<sup>3</sup>

While investigating the early development and placentation of the South Indian rodent *Bandicota malabarica*, I happened to come across a few tubular ova which I believe are newly fertilised ones. They were obtained while sectioning the fallopian tubes of an animal which had well formed corpora lutea in its ovaries. As observed by Pincus and others the follicle cells have all become free from the ova and are scattered in the lumen of the fallopian tubes. The features of the cytoplasm and the well formed chromosomes situated eccentrically suggest that the ovum is a healthy one. According to Smith<sup>4</sup> the unfertilised tubular ovum of Opossum while remaining intact shows signs of degeneration such as a well vacuolised cytoplasm and clumped or fragmented chromatin. Similar degenerative features are not seen in the ovum under consideration and hence the ovum is believed to be healthy and fertilised.

Towards one pole of the ovum is a small conical elevation which in all probability is the fertilisation cone. By the side of the fertilisation cone is a short rod-like body situated well within the cytoplasm which seems to be the sperm head. The nucleus of the ovum has entered an advanced division stage. The polar view of the division spindle with distinct chromosomes can be seen in the photograph. This division stage is to be taken as the final maturation division because the sperm has only just entered the egg and is still far away from the egg nucleus. This is in accordance with the view of Arey<sup>5</sup> who states that the egg in mammals when ovulated has completed the first polar body whereas the second polar spindle is present in an arrested state. The second maturation division is gone through only during the preliminary events of fertilisation.

A fuller account of the early development and placentation of the species will be published elsewhere.

My thanks are due to Dr. P. N. Ganapati and to Professor R. Gopala Aiyar for help and encouragement.

Dept. of Zoology, K. KRISHNAN NAYAR.  
Andhra University,  
Waltair,  
February 21, 1952.

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#### PERSISTENT POLLEN TUBES IN *ANTIGONON LEPTOPUS* HOOK ET ARN

USUALLY, the pollen tubes, in the ovules of angiosperms collapse and vanish soon after fertilization. However, a few departures from this usual behaviour are on record, namely, *Galinsoga ciliata*, *Ulmus americana*, *Hicoria pecan*,<sup>2</sup> *Ottelia alismoides*, *Hydrilla verticillata*,<sup>3</sup> *Orybaphus nyctagineus*<sup>1</sup> and in *Malvaceae*.<sup>4</sup>

This note puts on record the occurrence of persistent pollen tubes in *Antigonon leptopus*, a member of the family Polygonaceae. The pollen tubes have been found to persist in the micropylar part of the ovules up to an advanced stage of the development of the embryo in this plant. The pollen tube is unbranched and about 8  $\mu$  in diameter. It stains uniformly (red with safranin) and shows no recognisable cytoplasmic contents. Therefore, it looks improb-



able that these perform any haustorial function in this plant.

I wish to express my sincere thanks to Prof. J. Venkateswarlu for his guidance and to Mr. C. Venkatarao for his suggestions.

Dept. of Botany,  
Andhra University,  
Waltair,  
February 8, 1952.

B. S. SIVA RAO.

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#### EMBRYOLOGY OF SABIACEAE

SABIACEAE includes four genera of which *Meliosma* is the largest with nearly sixty species. Very little is known about its embryology, except for some very brief notes by Mauritzon<sup>1</sup> on some embryological features of *Meliosma Arnottiana*, *M. obtusifolia*, *M. pyriantha*, *M. monophylla*, *M. myriantha*, *M. tenuis*, *M. tsangtakii* and *Sabia javanica*. Preserved and pressed materials of these were studied by him up to the time of fertilisation. In the present note some observations on three species of *Meliosma* are recorded some of which have not been mentioned by Mauritzon.<sup>1</sup>

The young anther wall shows four layers external to the tapetum. The endothecium develops fibrillar thickenings. The tapetum is of the glandular type and its cells are binucleate. The tapetal nuclei show a tendency to secondary fusion and subsequent division. Sixteen bivalents were counted during the first division of the microspore mother cell of *Meliosma Wightii* (Fig. 1). The pollen grain is two-celled at the shedding stage. In *Meliosma Arnottiana* the generative cell is elongated (Fig. 2) but in *M. Wightii* it is lenticular.

The superior ovary is bilocular and each locule encloses two pendulous unitegmic ovules (Fig. 3). Clustered crystals are present in the cells of the ovary wall. The integument does not organise a micropyle (Figs. 5 & 7). The development of the female gametophyte is of the Polygonum type (Figs. 4 & 5). The synergids in *Meliosma Arnottiana* are hooked, but simple in *M. Wightii* and *M. simplicifolia*. The egg is situated between them. The secondary nucleus is in the diverticulum near the chalazal region of the embryo sac (Fig. 5). The antipodals are organised as definite cells and degenerate early; but in *Meliosma Arnottiana* they persist for some time during early post-

fertilisation stages. In *Meliosma Arnottiana* cases of supernumerary pollen tubes entering the mature embryo sac were observed (Fig. 6).

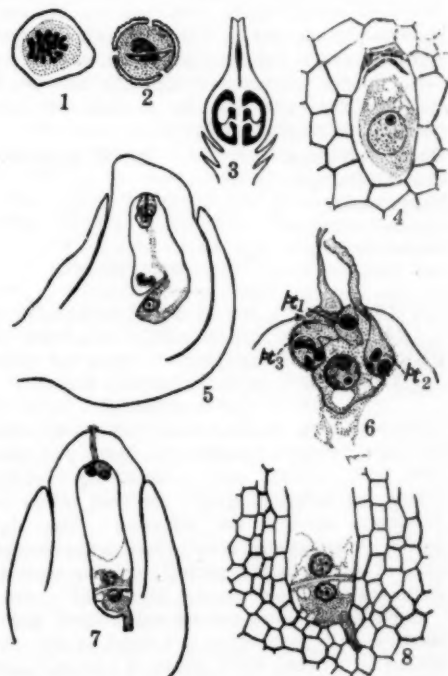


FIG. 1. Polar view of dividing pollen mother cell showing sixteen bivalents  $\times 450$ . FIG. 2. Mature pollen grain  $\times 450$ . FIG. 3. L. S. ovary to show the arrangement of ovules. FIG. 4. Tetrad of megaspores  $\times 450$ . FIG. 5. L. S. ovule showing mature embryo sac with the diverticulum  $\times 135$ . FIG. 6. Supernumerary pollen tubes near the fertilised egg  $\times 450$ . FIG. 7. The upper and lower chambers formed after the transverse division of primary endosperm nucleus  $\times 135$ . FIG. 8. Same enlarged to show the process developed from the lower chamber  $\times 225$ .

In all the species under investigation, the development of a diverticulum from the embryo sac is a characteristic feature. This diverticulum which is formed during the development of embryo sac, grows always towards the funiculus. The secondary nucleus is now present in the diverticulum and triple fusion occurs here. The primary endosperm nucleus, in the diverticulum, divides by a transverse wall resulting in the formation of two chambers. The nucleus in the lower chamber divides and this chamber remains binucleate throughout. Also, one or more haustorial processes develop from this lower chamber (Figs. 7 & 8).

The mature embryo is dicotyledonous and the hypocotyledonary region is twisted. The fruit is a drupe enclosing inside an albuminous seed. The remaining seeds degenerate. In *Meliosma simplicifolia*, degeneration of seeds is found to be due to the entry of an insect larva at about the time of anthesis.

My thanks are due to Prof. L. N. Rao, Dr. K. Subramanyam and Mr. M. A. Rau for kind encouragement and guidance.

Dept. of Botany,  
Central College,  
Bangalore-1,  
March 12, 1952.

M. V. S. RAJU.

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#### THE EFFECT OF A PRELIMINARY PERIOD OF DARKNESS ON THE PERCENTAGE GERMINATION OF THE SEEDS OF *ANISOCHILUS ERIO-CEPHALUS* BENTH.

SEEDS collected in November, 1947, were used in experiments conducted in April and May, 1948, both in light and in dark. By 'light' is meant the diffuse daylight received inside the laboratory through the windows. The 'light period' thus included about 10-11 hours of darkness at night. 'Dark period', on the contrary, indicates total darkness for all the 24 hours.

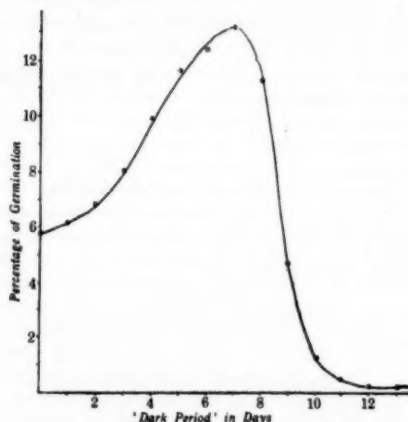
Experiments were carried out with 15 sets of seeds, each set consisting of a batch of 500 seeds placed in between moist pieces of blotting paper. One set was kept in light and the remaining 14 in dark. Each day one of these latter sets was removed to light and the day-to-day germination was noted in all the 15 sets. The whole experiment was duplicated and the mean of the two is shown in the graph (Fig. 1).

It is seen that a period of preliminary continued darkness has a definite and very marked effect upon the percentage of germination which increases first with the increase in this 'dark period', reaches a maximum of 13.4 per cent. for 7 days and then falls sharply almost to zero on the 12th day.

Other useful observations made were:

(1) The maximum germination for a particular day was observed on the 4th day of receiving light; (2) After remaining for 6-9 days in dark, about 0.3 per cent. of the seeds could germinate after only one day's exposure to light; (3) After removal of the seeds to light the germination stopped completely from the 11th day of the 'dark period'; and (4) The germination in dark was almost constant

(about 0.3 per cent.) and was observed usually on the 6th day.



It may be recalled that a number of authors have noted the varied influence of light on the germination of seeds. Of these the case of *Lythrum salicaria* studied by Lehmann<sup>1</sup> (quoted in Stiles, *Plant Physiology*<sup>2</sup>) is most striking. He found that an exposure of the seeds previously kept in dark to a light intensity of 730 metre candles for just 0.1 second increased the germination from 7 per cent. to 50 per cent. A similar case has been noted above for *Anisochilus eriocephalus* where the percentage of germination in dark, irrespective of an increase in the period, remains constant but an exposure to light for even a short period, after a particular duration of preliminary darkness, is sufficient to bring about an appreciable increase in the percentage. The interesting new observation is that a further increase can be obtained when the seeds are subjected to a preliminary period of darkness. Hence, the influence of light on germination must be considered in relation to other factors.

It gives me great pleasure to thank Dr. R. Misra of the University of Saugar where this work was carried out, for his valuable help and guidance.

Department of Botany,  
Birla College,  
Pilani,  
Rajasthan,  
April 10, 1951.

T. S. BAKSHI.

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## REVIEWS

### Radiochemical Studies: the Fission Products.

Books 1, 2 & 3. Edited by Charles D. Coryell and Nathan Sugarman. National Nuclear Energy Series Manhattan Project Technical Section, Division IV—Plutonium Project Record—Vol. 9. (Published by McGraw Hill Book Co. Inc., New York), 1951. Pp. 2086. Price \$18.50 per set.

This is a record of the research work accomplished under project contracts on the fission products during the war years. A total of 336 research papers make up the complete set made into three volumes for the sake of convenience.

Book I consists of four parts dealing with: (i) Counting Techniques—11 papers; (ii) Chemical Studies at Tracer Levels—12 papers; (iii) Remote Control Techniques—10 papers; and (iv) Studies of the Fission Process—19 papers.

Books II and III contain 173 research papers dealing with (v) the 'Radioactivity of Fission Products', of which 147 dealing with the radioactivity of elements ranging from Zinc ( $Z=30$ ) to Europium ( $Z=63$ ) form Book 2. The remaining 26 papers on 'Fission Yields' in  $U^{235}$ ,  $U^{238}$ ,  $Pu^{239}$  irradiated with fast and slow neutrons forming Part (v) are continued in Book 3. Part (vi) gives the 'Radiochemistry of Fission Product Elements'—85 papers, Part (vii) the 'Special Studies of Gaseous Fission Products'—7 papers and Part (viii) the 'Radiochemical Studies of Other Activities'—19 papers.

The set thus gives not only the radiochemistry of the fission products, as the name signifies, but full details of the instrumentation necessary in the measurements of activities and in handling, by remote control, materials with considerable activities as they come out of the reactor. The methods of separation and purification of compounds of elements about which little was known upto 1940, have been described in great details in these papers. The methods will be found useful to the analytical chemist whether he is dealing with radio-active or inactive mixtures. To the nuclear chemist, as also to the nuclear physicist, they will be of very considerable value.

A certain amount of repetition is observed. Also data given in one paper sometimes is found to contradict that given in another. This is perhaps inevitable in a work of this nature. Far from detracting from the value of the

work, it gives a historical background of the development of the projects and also indicates the necessity of this overlapping in the interests of maintaining secrecy. The footnotes indicate the data which are dependable. A small summary given at the beginning of each chapter adds to the usefulness of the books.

The introductory chapter gives the terminology adopted in the text. The book contains numerous figures, plates and circuit diagrams which will enable the reader in the field not only to understand the paper but to set up the equipment in one's own laboratory. The appendices give the 'Fission Products Decay Chains', 'Fission Yield' and 'Nuclides Formed in Thermal Fission'. A full author and general index complete the set.

The books will be a valuable addition to any library and an indispensable set for a nuclear chemist or physicist.

JAGDISH SHANKAR.

Further Laboratory and Workshop Notes. Compiled and edited by Ruth Lang for the Institute of Physics, London. (Edward Arnold & Co.), 1951. Pp. 290. Price 28 sh.

In the *Journal of Scientific Instruments* published by the Institute of Physics, London, there is a section on Laboratory and Workshop Notes. This was introduced in the year 1930 so as to serve as a medium through which devices, special methods, etc., evolved in one Laboratory or Workshop could be passed on to other workers. Most of the important notes which appeared in this section of the *Journal of Scientific Instruments* before the year 1946 were reprinted in the form of a book entitled *Laboratory and Workshop Notes*. This was compiled and edited by Miss Lang on behalf of the Institute of Physics. This publication was very well received by the scientific world. The same author has now made a second selection of the notes from 1946 onwards with the addition of several from the earlier years for which there was no room in the first volume.

In the volume under review, the notes have not been reprinted as such, introductory paragraphs and acknowledgments having been omitted. Some of the notes have been condensed and the trade names of products generally

omitted. The authors of the respective notes have in many cases brought the information contained in their notes up-to-date. There are on the whole one hundred and twenty-four notes which have been classified under seven sections: (1) graphs and drawings, (2) optical devices and techniques, (3) devices for liquids and gases, (4) heat, thermometry and furnaces, (5) laboratory and workshop tools, processes and devices, (6) vacuum and pressure techniques and devices, and (7) electrical devices and ancillary equipment and techniques. The book is also provided with a subject-index which will be very useful to the reader.

The presentation of the Laboratory and Workshop Notes in a collective form makes them readily available to the workers in the laboratory. The book will be found to be indispensable to those who are interested in preparing some gadget or other for their experimental problems. It should therefore find a place in every physical research laboratory.

R. S. K.

**Survey of Modern Electronics.** By P. G. Andres. Published by John Wiley & Sons, Inc., New York, (Chapman & Hall, Ltd., London), Indian Agents. Asia Publishing House, 17, Gunbow Street, Bombay-1. Pp. x + 522. Price \$ 5.75.

This book is a welcome addition to the available literature on the subject. It is divided into eleven chapters. Commencing with the basic ideas of electron emission, the theory of the diode, triode, multi-electrode tubes, cathode-ray oscilloscope, klystron, magnetron, thyatron, etc., are developed. The electron microscope, the mass spectrometer, the cyclotron, the betatron, etc., also come up for elementary treatment. Photosensitive tubes and devices are also adequately dealt with. The last four chapters are devoted to electronics in instrumentation, electronics in communication, electronic controls and electronics in heating. The book is thus self-contained and complete in itself as providing a complete review of the present position of electronics.

The treatment is everywhere clear and correct and the book is most readable. As matters stand to-day, a course in electronics is very necessary for civil, mechanical, electrical, chemical and metallurgical engineers, physicists and chemists. To students taking all these courses in the Universities, this book can be most heartily recommended. Students of communication will find this book very useful in

the preliminary stages as a most readable introduction. The book should find a place in every engineering school or college library.

The printing and get-up of the book are of the high standard we have come to expect of the publishers. The photographs are well printed. The diagrams are well drawn and extremely well reproduced. The price is, therefore, most reasonable.

S. V. CHANDRASEKHAR AIYA.

**Theory and Design of Valve Oscillators.** By H. A. Thomas. Second Edition. (Published by Chapman & Hall, London), 1951. Pp. xvi + 317. Price 36 sh. nett.

This book is the seventh volume of the well-known monographs on electrical engineering edited by H. P. Young. The author has made important contributions in the field and the book has the stamp of authority. The second edition is a vast improvement over the first and incorporates all the major developments in the field. The first six chapters are devoted to LC oscillators. The different types, the question of amplitude, wave form, efficiency frequency stability, frequency stabilisation, etc., all come up for detailed treatment. RC crystals, U.H.F., Klystron and Magnetron oscillators are considered in separate chapters. Chapters on the klystron and magnetron oscillators are most readable. There is a very valuable bibliography at the end containing references to 172 well-chosen and valuable papers.

The printing and get-up of the book are good. The book is indispensable to Honours students in Communication Engineering, to research workers interested in the field and to advanced students in Physics specialising in Wireless.

The reviewer would have appreciated the inclusion of a chapter on RC oscillators used for pulse and saw tooth generation, as that would have made the book complete in itself. It is to be hoped that this omission will be made good in a subsequent edition.

S. V. CHANDRASEKHAR AIYA.

**Power System Analysis.** By J. R. Mortlock and M. W. Humphrey Davies (Published by Chapman & Hall), 1952, Pp. 384. Price 45 sh. nett.

A post-graduate vacation course on "Power System Analysis" was held in 1949 at the Imperial College, London, with the primary object of exchanging information between power system engineers, research workers and teach-



ers concerning current difficulties and recent advances in the application of steady state network theory to the problems encountered in power system engineering. The book under review is based upon notes circulated for the course, and the discussions which followed. The book is intended primarily for those who already have some experience of power system work.

The book opens with a chapter on A.C. circuits followed by solution of simple networks and method of symmetrical components. Chapters IV and V deal with the characteristics of underground cables and characteristics of overhead lines respectively. Chapters VI and VII are devoted to equivalent circuits of transformers and synchronous machines, while Chapter VIII deals with characteristics of loads. A chapter has also been included on stability of A.C. power systems. Chapter X deals with control of watts, vars and voltage and Chapter XI on systematic computation. Two chapters have also been included on the application of matrix algebra to network problems. The book concludes with a chapter on Network Analysers which are so invaluable in present-day power system studies and a chapter on power system design.

In view of the wide range of subjects covered, the book can best be treated as a good introduction to specialised publications, to which numerous references have been made in the text. The printing and get-up of the book are excellent and leave little to be desired. Unfortunately, the present trend in price of technical publications seems to be still on the rise and the rather high cost of the book may go against an average buyer.

H. N. RAMACHANDRA RAO.

**Indian Vegetable Oils as Fuels for Diesel Engines.** By J. S. Aggarwal, H. D. Chowdhury, S. N. Mukherji and L. C. Verma. (C.S.I.R., New Delhi), 1952. Pp. 31. Price Re. 1.

The Bulletin is a well-written general review, on the possibilities of the utilisation of Indian Vegetable Oils as Diesel Fuels and also includes the results of some experiments conducted by the authors. The survey of previous work at the beginning and in the Appendix give a good summary of the work previously done on the subject. The *General Requirements of Diesel Fuels* is written in very easy language and we believe is intended chiefly for non-technical people. The review of the tests conducted by the authors includes a table on the

properties of the various oils used by the authors, and also summarises the suitability of the oils as diesel fuels but, as the authors themselves have stated, these results are by no means conclusive. Thus, in spite of the discouraging results obtained by the authors while using castor oil, it may still be possible to use it in diesel engines with suitable modifications, say, either by pre-heating the fuel or increasing the injection pressure, etc. The authors have not included a schematic diagram of the shape of the combustion chamber, the position of the injector nozzle, etc., so that factors which possibly influence the process of combustion remain undefined. After studying the Bulletin, one agrees with the authors that more work still remains to be done on this important problem.

H. A. HAVEMANN.

**Chemistry of Carbon Compounds.** (Modern Comprehensive Treatise). Edited by E. H. Rodd. Vol. I, Part A. General Introduction and Aliphatic Compounds (Elsevier Publishing Co., London and New York). Pp. 777.

The present volume is part of a comprehensive treatise in Organic Chemistry written by a team of distinguished chemists and is intended to fill a place intermediate between the great encyclopaedias like 'Beilstein' and instructional works like 'Karrer'. It is a successor to Richter's *Organic Chemistry* and the original framework and classification are maintained. The subject-matter is quite up to date and contains all the advances of recent years.

Part A of Volume I includes a long introductory chapter having special sections on important general aspects of organic chemistry. These consist of a number of essays dealing with the physical properties of carbon compounds, and important aspects of physical chemistry by writers who have made special study of these. Particular emphasis is given to stereochemistry and reaction mechanism. Under analytical chemistry are described micro and semi-micro-methods. The next eleven chapters bring the subject upto dicarbonyl compounds. Obviously there will be one more part in Vol. I. No clear indications are given of the total number of parts that will come out, though it is stated there will be five volumes.

In a work of this nature written by many authors some unevenness of treatment can be expected. This is conspicuously absent in the present volume. There is no doubt that it will prove to be a very valuable companion to all



organic chemists providing authoritative information. The value of the work is further enhanced by references given to original sources, to reviews and to special articles.

T. R. SESHADRI.

**The Chemistry and Technology of Food and Food Products.** Vol. II. Edited by Morris B. Jacobs (Interscience Publishers, Inc., New York, London), 1951. Pp. xxvi + 833-1,770. Price \$ 15.00.

In this thoroughly revised and unified collaborative effort, experts in individual food fields have included the latest knowledge that has accumulated since the publication of the first edition in 1945. This volume, comprising Part Four of the series, contains a mine of useful information on the descriptive aspects of particular food groups. Some account has also been given of their history, statistics, definitions, standards (U.S.), composition and chemistry. A balance has been maintained throughout the book between the sciences of agriculture, botany, food chemistry, biochemistry, nutrition and food microbiology. The treatment is in general concise, but certain important aspects like the curing of meat, the factors in influencing quality in bread, storage changes of individual food products and the conditions under which spoilage can be minimised in them, have been dealt with in good detail. The statistical data are often representative only of American food products. This is so especially with the chapter on "Poultry and Eggs", which has obviously been written purely from the point of view of this American industry, which from humble beginnings has now become a billion dollar industry. In practically every chapter the authors have tried to enumerate both edible and inedible by-products obtainable from various food groups. Tropical food products like millets among the cereals and mango and jackfruit among the fruits do not find mention in this otherwise authoritative compilation. It is also rather surprising that there has been no data reported on the vitamin B<sub>12</sub> content of milk and other products.

In the years to come, biochemists and food experts will doubtless have to explore many food fields as yet untouched. Nevertheless, the valuable collection of material on food and food products presented in this series should prove to be of immense advantage to food technologists of both professional and practical training.

A. SREENIVASAN.

**The Chemistry and Technology of Food and Food Products.** Vol. III. Edited by Morris B. Jacobs (Interscience Publishers, Inc., New York-London), 1951. Pp. xxx + 1,771-2,580. Price \$ 15.00.

The support received by the processed food industry from the army during the last World War resulted in such tremendous development in methods of manufacture, instrumentation, materials of construction, packaging and quality control that a complete revision of Vol. II of the last edition (1945) has now been necessitated.

The volume is divided into two parts—Part Five deals with the principal methods of food preservation and includes chapters on preservation by canning, dehydration, temperature control, and by use of micro-organisms; chemical preservatives and packaging are also discussed. The treatment is again general but individual aspects such as factors influencing processing of canned foods, role of salt in preservation and freezing of foods receive adequate attention.

Part Six is devoted to methods of production of individual food products. The chapters on "Sugars and Syrups" and "Production of Non-Alcoholic Beverages" are from new contributors. The importance of enzymes in the production of food products has caused the inclusion of a chapter on this subject. Another notable addition is the chapter on "Manufacture of Chewing Gums". Detailed description of production methods as well as flow diagrams and photographs of latest equipment are presented throughout. Due emphasis is given to materials of construction and to the nutritive value of the products.

A feature of the chapter on "Oils and Fats" is the inclusion of a description of modern semi-continuous deodorizing apparatus and of rotator fat pasteurizing apparatus. The chapter on fruit juices includes an excellent account of concentration by single effect force circulation evaporation and by means of a recompression evaporation system.

Part Five ends with a chapter on packaging which often makes or mars the fortunes of a food product in the market, while Part VI also ends appropriately with a chapter on "Industrial Waters" used for various purposes in the manufacture of food products.

This set of 3 volumes has, to date, been the ablest and most complete account yet available on the subject. The contributors have succeeded admirably in integrating food science with food production and processing procedures.

Attention has been focussed on the needs of the practical man and the scientist alike. As such, these volumes should prove invaluable to students of food technology and to personnel engaged in food industry.

A. SREENIVASAN.

**A Text Book of General Physiology.** By Hugh Davson. (J. A. Churchill, Ltd., London), 1951. Pp. xii + 659. Price 45 sh.

The aim of the book is to make a comprehensive and critical survey of the results of modern research in the field of general physiology. Although Dr. Davson has undertaken the formidable task of covering a very wide field, yet he has succeeded in giving a clear, comprehensive and intelligent account of the principles of general physiology in terms of concepts familiar in the basic sciences of physics and chemistry.

The text is divided into six parts. After discussing the structural basis of living matter, the author deals with the transformation of energy in living systems and transport of water and solutes, where he gives an interesting account of permeability and structure of plasma membrane, of absorption from intestine and secretion of gastric acid. The sections on muscles, nerves and discussion on light and its effect on and its emission by the organism are very illuminating.

The excellence of Dr. Davson's book is all round and hence it is difficult to choose any one section for special praise. The whole book is full of valuable information. The graphs and figures are well-chosen and the list of reference is exhaustive. The book will certainly stimulate much interest amongst students of physiology and the related sciences of botany, zoology and medicine.

N. N. DE.

#### Books Received

**Structural Chemistry of Inorganic Compounds, Vol. II.** By W. Huckel. (M/s. Elsevier Publishing Co.), 1951. Pp. x + 441-1,094. Price 90 sh.

**The Magnetron.** By R. Latham, A. H. King and L. Rushforth. (M/s. Chapman & Hall), 1952. Pp. ix + 142. Price 18 sh.

**Soil Chemistry.** By M. Y. Shawarbi. (M/s. Chapman & Hall), 1952. Pp. x + 420. Price 32 sh.

**Medicinal Chemistry, Vol. II.** By Alfred Burger. (Interscience Publishers), 1951. Pp. xv + 579-1,084. Price \$10.00.

**Modern Trends in Physiology and Biochemistry.** Edited by E. S. Gusman Barron. (M/s. Academic Press), 1952. Pp. xxii + 538. Price \$8.50.

**The Action of Hormones in Plants and Invertebrates.** Edited by K. V. Timann. (M/s. Academic Press), 1952. Pp. viii + 228. Price \$5.80.

**The Dynamics of Faulting and Dyke Formation with Applications to Britain.** (2nd Edition). By E. M. Anderson. (M/s. Oliver & Boyd), 1951. Pp. x + 206. Price 22 sh. 6d.

**Sugar Industry in India and Abroad.** By P. C. Goswami, Gauhati, 1951. Pp. 72. Price Rs. 3.

**Plane and Spherical Trigonometry, 3rd Edn.** By Lyman M. Kelles, Willis F. Kern and James R. Bland. (M/s. McGraw Hill), 1951. Pp. xi + 290.

**Astrophysics.** Edited by J. A. Hynek. (M/s. McGraw Hill Book Inc.), 1951. Pp. xii + 703.

**Bioluminescence.** By E. Newton Harvey. (M/s. Academic Press), 1952. Pp. xvii + 649. Price \$13.00.

**Thiophene and Its Derivatives.** By Howard D. Hartough. (Interscience Publishers), 1952. Pp. xvii + 533. Price \$16.50 (Sub. Price \$15.00).

**The Enzymes, Vol. II, Part II. Chemistry and Mechanism of Action.** Edited by Karl Myrback and James B. Sumner. (M/s. Academic Press), 1952. Pp. xi + 791-1,440. Price \$14.00.

**The Chemistry of Lignin.** By Friedrich Emil Brauns. (M/s. Academic Press), 1952. Pp. xv + 808.

**Advances in Carbohydrate Chemistry, Vol. VI.** Edited by Claude S. Hudson and Sidney M. Cantor. (M/s. Academic Press), 1951. Pp. xi + 441. Price \$8.50.

**The Chemistry of Synthetic Dyes, Vol. I.** By K. Venkataraman. (M/s. Academic Press), 1952. Pp. xvi + 704. Price \$14.50.

**An Introduction to the Embryology of Angiosperms, 1st Edn.** By P. Maheswari. (M/s. McGraw Hill Book Co.), 1950. Pp. x + 435. Price 52 sh. or \$6.00.

**Flora of the British Isles.** By A. R. Clapham, T. G. Tutin and E. F. Warburg. (Cambridge University Press), 1952. Pp. li + 1,591. Price 50 sh. net.

**Name This Insect.** By Eric Fitch Daglish. (M/s. Macmillan & Co.), 1952. Pp. xxvi + 294. Price 15 sh. net.

**Radio Astronomy.** By Bernard Lovell and J. A. Clegg. (M/s. Chapman & Hall), 1952. Pp. 238. Price 16 sh.

## SCIENCE NOTES AND NEWS

Exposed Inferior Ovaries in *Cucurbitaceae*

Prof. K. N. Kaul, Herbarium, National Botanical Gardens, Lucknow, writes as follows:

Following the observations<sup>1</sup> on half-inferior ovary in a variety of Kharbooza, *Cucumis melo*, an intensive search was made to find the behaviour of the ovary in other cucurbits. In the following cultivated species it was found that the ovary shows a tendency to expose itself habitually: *Luffa acutangula* Roxb., *Lagenaria vulgaris*, Ser. Var. with fruits broader at the upper end. In a very exceptional case an exposed ovary was also found in a late variety of *Cucumis melo* L. var. *momordica* (Phut).

1. *Curr. Sci.*, 1951, 20, 303.

*Cucurbita pepo* in Experimental Tuberculosis

*Cucurbita pepo* (Synonym: *Kooshmanda*, *Boodigumbala*) is widely recommended in indigenous medicine both as curative for the disease and restorative during convalescence of tubercular patients. The studies of M. Sirsi, P. R. J. Gangadharan and R. Rama Rao, Indian Institute of Science, have shown that water and acetone extracts of the fruit pulp inhibit the growth of virulent strains of *Mycobacterium tuberculosis* *in vitro*. The water extract also retards the progress of the disease in experimental tuberculosis of mice, thus lending experimental support for the use of this well-known Ayurvedic remedy.

Occurrence of *Codium* on the Coromandel Coast

Shri T. Sreeramulu, Department of Botany, Andhra University, writes as follows:

Recently the writer collected a few specimens of a species of *Codium* which answers to the description of *C. Iyengarii* Borges., from Waltair Coast. These plants were found growing attached to rocks in the littoral region together with other algal members. The occurrence of this genus on the East Coast north of Krusadai Islands is not known so far and the object of this note is to put the same on record on the Coromandel Coast of India.

The author's thanks are due to Prof. J. Venkateswarlu for kind encouragement.

## Research Degree Awards

On the recommendation of a Board of Examiners consisting of Dr. B. Prasad, Dr. N. R. Dhar and Dr. B. N. Ghosh, the Ph.D. Degree of the Utkal University was conferred on Sri. Sukumar Aditya for his thesis on "Studies on the Behaviour of Some Bi-Univalent Salts in Aqueous Solution".

The University of Poona has awarded the degree of Doctor of Philosophy in Chemistry to Sri. M. G. Marathe for his thesis entitled "Structure and Constitution of Flavones and Flavonols".

## Institution of Chemists (India) Silver Jubilee

The Institution of Chemists (India) proposes to celebrate its Silver Jubilee in December, 1952, with Sir J. C. Ghosh, Director, Indian Institute of Technology, Kharagpur, as Chairman, U. P. Basu, Director, Bengal Immunity Research Institute, Calcutta, as Secretary (Publication), and R. N. Chakaravarti, Professor of Chemistry, School of Tropical Medicine, Calcutta, as Secretary (Management). A brochure is to be published to commemorate the Society's services to the profession, industry and the State during the period.

The brochure is expected to contain contributions from several distinguished Indian Chemists.

## I. G. Farben Central Laboratory Index

A micro-film photographic facsimile of the I. G. Farben Central Laboratory Index is available at the D. S. I. R. Technical Information and Documents Unit, Lacon House, Theobalds Road, W.C.1. The Index can be inspected by appointment and no charge is made for inspection. Photo copies of entries may be ordered and purchased.

Most of the entries refer to dye-stuff, but the index also covers resins, plastics, detergents, wetting agents, water-proofing and emulsifying agents, textile assistants, rubber accelerators, cellulose esters, synthetic rubber, oil additives, tannins, insecticides, solvents, pharmaceutical products and other commodities.

## New Drugs for Tuberculosis

Three isomers of niacin have been produced independently by two well-known pharmaceu-

tical firms, Hoffman-La Roche Inc. and E. R. Squibb & Sons, for fighting tuberculosis.

They are isonicotinic acid hydrazine, 1-isonicotinyl-2-isopropyl hydrazine and a flucosyl derivative of it. Of the three, the first has proved the most effective.

Tuberculosis of the throat, the tongue, the intestinal tract and other tissues have responded to the treatment, and beneficial results have been reported in the most persistent form of the disease, bone tuberculosis, and also in meningitis.

The use of the drugs is still in the experimental stage and further tests have to be made before they are put on the market.

#### UNESCO Scheme for Safe Transit of Delicate Scientific Instruments

The scheme is designed to prevent delicate instruments from being delayed or damaged during customs inspection. The arrangement proposed by UNESCO provides for the inspection of such instruments to be made in the laboratories themselves, under competent supervision, rather than in customs depots at national frontiers or terminals. Each participating Government would name the laboratory or laboratories in its country to which it wished to extend the privileges of the scheme.

The actual procedure might vary from country to country, but UNESCO will keep a register of laboratories designated by governments and would periodically send to interested countries a list of these laboratories, as well as details of operation. Information reaching UNESCO by June 1, 1952, will be included in the first circular.

#### Copper-8-Quinolinate for Weather-proofing

In soluble form and mixed with waxes, oils and fats the compound shows an amazing and unexplained resistance to leaching and weathering. Fish-netting, impregnated with the fungicide, contained practically as much copper and retained its freedom from mould-growth after 3,000 hours in fresh-water as when new. Manila ropes similarly treated were just as strong after burial for a year; untreated ropes disappeared within 60 days.

#### Krilium

Krilium is described as a synthetic substitute for the natural humus which is normally plen-

tiful in virgin, fertile soils, but scarce in silt and clay soils of poor structure. The chemical is a polyelectrolyte and carries negative electrical charges which react with positive charges in soil minerals to give the soil its proper structure. One lb. of krilium has essentially the same effect on soil as 200 lb. of peat moss or 500 lb. of commercial compost.

It is believed that krilium brings about immediate improvement of heavy soils that pack down when wet, form hard clods when cultivated, and crust over during dry periods. If these claims prove justified, farmers throughout the world may eventually use krilium or something similar to it to reclaim barren clay fields once considered unfit for cultivation.

#### Symposium on Paints and Varnishes

A symposium on Paints and Varnishes was held at the National Chemical Laboratory, on March 6th and 7th, 1952. More than forty research and technical papers on raw materials, manufacture, testing and special purposes, coatings were presented in the two-day session. Special discussions on the subjects of "Accelerated Weathering" and "Cashewnut Shell Liquid" were also arranged. The Director, National Chemical Laboratory, inaugurated the symposium.

#### Ferroxdure

Ferroxdure, a new magnetic material announced by the Philips Research Laboratories (Holland), is a ceramic product, produced like china-ware by sintering or firing. Nickel and cobalt, which are nearly always present in magnet steel, are not necessary for its formation, it being only an oxide and not a metal. Its magnetic properties are considered so favourable that it is quite likely to replace the magnet steel at present used for permanent magnets.

#### CORRECTION

In the note on "An Antidiabetic Principle from *Rivea cuneata* (Wright)" (Vol. 21, No. 3, p. 69, Col. 1, para 5), the sentence beginning "The glycoside. . . ." should read as follows: "The glycoside was given orally to rats in daily doses of 5 mg. dissolved in water, 8 days after they received sub-cutaneous injections of 200 mg./kg. of alloxan."

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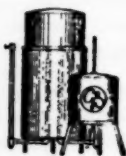
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